

## WHAT IS CLAIMED IS:

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1. An X-ray tube subsystem comprising:
    - an X-ray tube including a grid bias connection, a filament bias connection, and an anode bias connection; and
    - a grid voltage supply connected to the grid bias connection, the grid voltage supply adapted to produce an ion collection voltage substantially less than an electron beam focus voltage.
  - sub D1 > 2. The X-ray tube subsystem of claim 1, wherein the ion collection voltage is in the range of 10 to 30 volts.
  3. The X-ray tube subsystem of claim 1, wherein the electron beam focus voltage is greater than 100 volts, and the ion collection voltage is in the range 10 to 30 volts.
  4. The X-ray tube subsystem of claim 1, further comprising a Faraday cage surrounding the grid voltage supply.
  5. The X-ray tube subsystem of claim 1, wherein the grid voltage supply is a variable grid voltage supply.
  - sub D1 > 6. The X-ray tube subsystem of claim 1, further comprising a filament voltage supply connected to the filament bias connection.
  7. The X-ray tube subsystem of claim 6, wherein the Faraday cage is connected to the filament voltage supply.
  8. The X-ray tube subsystem of claim 6, further comprising an anode voltage supply connect to the anode bias connection and a ground reference, and a cathode voltage supply connected to the earth ground and the filament bias connection.
  9. A method for operating an X-ray system to reduce high voltage breakdown events, the method comprising:
    - providing an X-ray tube that includes a grid bias connection and filament bias connection;
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during X-ray tube operation, creating an ion collection voltage between the grid bias connection and the filament bias connection that is substantially less than an electron beam focus voltage, to sweep free ions out of the X-ray tube.

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5 10. The method of claim 9, wherein the step of creating an ion collection voltage comprises creating an ion collection voltage in the range of 10 to 30 volts.

11. The method of claim 9, further comprising the step of calibrating the X-ray tube before examination to determine the ion collection voltage.

10 12. The method of claim 9, further comprising the step of providing a Faraday cage surrounding a grid voltage supply that creates the ion collection voltage.

13. The method of claim 12, further comprising providing a connection between the Faraday cage and the filament bias connection.

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14. An X-ray examination system comprising:  
an X-ray tube including a grid bias connection and a filament bias connection;

a grid voltage supply connected to the grid bias connection, the grid voltage supply adapted to produce an ion collection voltage substantially less than an electron beam focus voltage to sweep free ions out of the X-ray tube; ,

20 an X-ray detector positioned to receive the electron beam; and  
readout electronics connected to the X-ray detector.

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15. The X-ray examination system of claim 14, wherein the ion collection voltage is in the range of 10 to 30 volts.

25 16. The X-ray examination system of claim 14, further comprising a Faraday cage surrounding the grid voltage supply.

17. The X-ray examination system of claim 16, wherein the Faraday cage is connected to the filament bias connection.

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18. The X-ray examination system of claim 14, wherein the ion collection voltage is a precalibrated ion collection voltage.

19. The X-ray examination system of claim 14, wherein the free ions are positive ions generated in proximity to an X-ray tube cathode during operation of the X-ray examination system.

20. The X-ray examination system of claim 14, wherein the X-ray tube operates under a tube voltage substantially in the range 100-150kV, the electron beam focus voltage is greater than 100 volts, and the ion collection voltage is substantially in the range of 10 to 30 volts.

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